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NONCONTACT JOYSTICK

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[There are no amendments to this utility model.]

Claim

A noncontact joystick characterized in that in a joystick that is attached to a spherical member supported in such a manner that it can pivot freely around the center of the sphere, and wherein movements of the joystick are detected by means of magnetic sensors, the aforementioned spherical center member [sic] is made of a plastic magnetic member.

Detailed explanation of the model

The present model pertains to a joystick. In particular, it pertains to a joystick used for noncontact detection of a tilt angle of a control stick using a magnet and magnetic resistance elements.

As shown in Figure 1, a noncontact joystick 1 has a structure in which spherical member 3 attached to one end of control stick 2 is supported by supporting member 4 in such a manner that it can pivot freely around the center of the sphere; and the angle and direction that control stick 2 is tilted are detected by magnetic sensor 7, which is configured by permanent magnet 5 buried in spherical member 3 and a pair of magnetic resistance elements 6a and 6b fixed to supporting member 4, as contact-free electric signals. Because a higher level of accuracy and a longer service life can be attained than with a contact-type joystick that utilizes a volume-based or a mechanical fixed transducer, application to two-dimensional controllers of various kinds is expected.

As shown in the figure, a cylindrical permanent magnet magnetized in its axial direction, for example, is used for aforementioned permanent magnet 5, and it is buried in spherical member 3 (referred to as a resin ball, hereinafter) made of a nonmagnetic resin material, while its center axis is aligned with control stick 2. On the other hand, magnetic resistance elements 6a and 6b change their resistive values as they detect changes in the direction of the magnetic field generated by permanent magnet 5, and they are fixed to nonmagnetic resin supporting member 4 on planes perpendicular to a horizontal plane that goes through the center between the two poles of permanent magnet 5 while their magnetized planes are arranged orthogonally to each other. Therefore, as control stick 2 is pivoted, permanent magnet 5 buried coaxially [with the control stick] is pivoted as one body with control stick 2, directions of the magnetic fields applied to magnetic resistance elements 6a and 6b, which are arranged orthogonally to said fields, change in correspondence to the pivot angle of control stick 2, and the tilt angle and the direction of control stick 2 are resolved into quadrature components and detected by output terminals of magnetic resistance elements 6a and 6b.

Because aforementioned conventional noncontact joystick 1 is structured such that cylindrical permanent magnet 5 is buried in resin ball 3, a problem exists in that it is expensive due to the complexity of assembly as described below.

For example, resin ball 3 comprises 2 semi-spherical members 3a and 3b containing hole 8 created at the center into which control stick 2 is inserted and annular channel 9 in which cylindrical permanent magnet 5 is attached coaxially with said hole 8, and [the resin ball] is realized by combining said semi-spherical members 3a and 3b into one body using screws at the bottom parts. Although respective semi-spherical members 3a and 3b can be created by means of resin molding, it is difficult to attain a high level of precision in the measurements of the

respective parts. In particular, the dimensions of permanent magnet 5 as a sintered body are likely to vary significantly, and a difference is created between said [size of the permanent magnet] and of annular channel 9. A problem can exist in that they can be impossible to attach together, or in that the characteristics of the joystick are affected adversely due to jerky movements. In addition, because the magnetic fields applied to magnetic resistance elements 6a and 6b are subject to detection errors when curved magnetic fields created at the shoulder parts of the magnetic flux of permanent magnet 5 are applied, magnet 5 with a sufficient length (l) between the magnetic poles has to be used. Thus, spherical member 3 is up-sized, resulting in a problem that a compact member with a high level of detection accuracy is difficult to obtain.

The present model was created in light of the above situation, and it presents a noncontact joystick by which the device can be assembled easily, it can be down-sized easily, and stable characteristics can be attained.

The noncontact joystick pertaining to the present model is characteristic in that the spherical member attached to one end of the aforementioned control stick is made of a plastic magnet, and in that because there is no need to install a permanent magnet separately, its structure is simple and the ease of its assembly can be improved significantly. In addition, it offers excellent effects in that because the magnetic poles are created on the surface of the spherical member without burying a magnet therein, the dimensions can be reduced to said extent, and in that magnetic fields can be applied to the magnetic resistance elements effectively. An application example of the present model will be described in detail below with a figure.

Figure 2 shows noncontact joystick 11 pertaining to the present model, wherein, like the aforementioned conventional example, a structure is shown in which spherical member 12 is attached to one end of control stick 2, and said spherical member 12 is supported by supporting member 4 in such a manner that it can be pivoted freely around the center of the sphere. Here, the point that distinguishes it fundamentally from the conventional example is spherical member 12, while the other components and the detection principles are identical to those of Figure 1. Thus, the same functional components will be assigned with the same symbols, and their explanation will be omitted.

Said spherical member 12 is made of a plastic magnet. As shown in the figure, flat surfaces 12a and 12b are created parallel to each other at the top and bottom, respectively, and magnetic poles are created on said flat surfaces 12a and 12b. Then, side surfaces 12c and 12d, as continuation of flat surfaces 12a and 12b where the magnetic poles are created, form an arc-like cross section except for flat surface 12e created in the middle section. Said spherical member 12 is retained in arc-like supporting side surface 4a of supporting member 4 by the parts where said arc-like side surfaces 12c and 12d are formed in order for spherical member 12 to be pivoted freely around the center of the sphere and for the magnetic poles created on flat surfaces 12a and

12b at the top and the bottom to serve the role of the magnetic body for applying magnetic fields effectively and simultaneously to magnetic resistance elements 6a and 6b.

As described above, because a pair of parallel flat surfaces 12a and 12b are formed at a part of the spherical surface, the magnetized planes of spherical member 12 made of the plastic magnet can be attached firmly to said flat surfaces, so that uniform magnetization can be realized easily without locating minute magnetic poles eccentrically. That is, when insertion hole 8 of control stick 2 is created perpendicularly to magnetized planes 12a and 12b, the directions of the magnetic poles match the center axis of control stick 2. In addition, unlike the prior art in which a permanent magnet is provided separately, because the magnetic poles are created at the top and bottom of spherical member 12 itself, spherical member 12 can be down-sized to said extent. In addition, when the spherical member remains the same size, the length between the magnetic poles can be increased over the case in which a permanent magnet is buried, and essentially uniform parallel magnetic fields can be applied without applying a curved magnetic flux created at the shoulder parts of the magnetic poles to magnetic resistance elements 6a and 6b, so that the detection accuracy can be improved. In addition, the provision of flat surface 12e at the middle part offers the effects that spherical member 12 can be plastic-molded easily, and that a distorted distribution of magnetic fields due to burrs on the plastic can be reduced.

As described above, in the noncontact joystick pertaining to the present model, because the spherical member attached to the control stick is made of a plastic magnetic body, the number of components can be reduced, and the assembly becomes simplified. In addition, because a structure is adopted in which parallel flat surfaces are formed at a part of the spherical surface magnetic poles created on said flat surfaces, uniform magnetization can be realized, and a compact noncontact joystick with a high level of detection accuracy can be presented.

Brief description of the figures

Figure 1 is a cross section of a conventional noncontact joystick, and Figure 2 is a cross section of the noncontact joystick pertaining to the present invention.

11 ... noncontact joystick; and 12 ... spherical member.

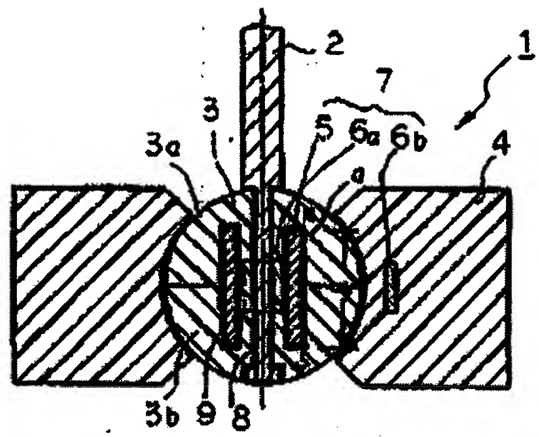

Figure 1

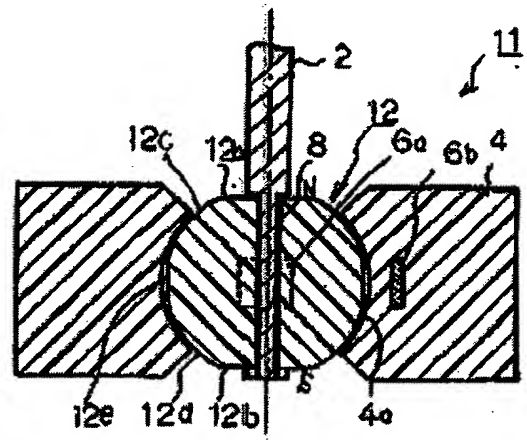

Figure 2